CLAIMS

We claim:

1. A radioactive material detection system comprising:

a cargo container monitoring system including:

a plurality of radioactive material detection apparatuses having a wireless transmitter, a radiation sensor configured to detect radiation over a predetermined or commanded period of time, a detection controller configured to send sensed radiation to the wireless transmitter for transmission and an identification tag electrically coupled to one of the controller and the wireless transmitter and configured to provide identification data or location data to the information being transmitted by the wireless transmitter; and

a master unit/master module having a receiver configured to receive the wirelessly transmitted information from each of the wireless transmitters of the plurality of radioactive material detection apparatuses, a transceiver and a master controller coupled to the receiver and configured to send the information received from the radioactive material detection apparatuses through the transceiver; and

a control center in communication with the transceiver of the master unit/master module, the control center being configured to receive data from at least one additional source other than the master unit/master module and to asynchronously analyze the data from the at least one additional source and the information from the radioactive material detection apparatuses so as to detect radioactive material in a particular container.

2. The radioactive material detection system of claim 1, wherein a first subset of the plurality of radioactive material detection apparatuses are arranged on a first container.

3. The radioactive material detection system of claim 2, wherein a second subset of the plurality of radioactive material detection apparatuses are arranged on a second container, the first and second containers being arranged such that the first subset of the plurality of radioactive material detection apparatuses is capable of detecting at least a portion of the second container.

4. The radioactive material detection system of claim 1, wherein the at least one additional source includes one of active container scanning systems, container manifests, container weight, container moment of inertia in one or more dimensions, container transit histories, container source logs, container destination logs, a country of origin log, a destination country log, and a field investigation report.

5. The radioactive material detection system of claim 1, wherein the transceiver communicates with the control center by using one of a cellular system, a wireless computer network, an infrared system, an ultrasonic system, a satellite system, and a radio system.

6. The radioactive material detection system of claim 1, wherein a plurality of subsets of the plurality of radioactive material detection apparatuses are arranged on a plurality of containers, the plurality of containers being arranged such that subsets of the plurality of radioactive material detection apparatuses arranged on adjacent containers are capable of detecting at least a portion of other adjacent or nearby containers.

7. The radioactive material detection system of claim 1, wherein at least two of the plurality of radioactive material detection apparatuses are arranged on a container, the at least two radioactive material detection apparatuses being oriented on the container in a manner that maximizes the coverage within the container.

8. The radioactive material detection system of claim 1, wherein the at least one additional source includes intelligence information about the shipper, the country of origin, the shipping route, transit country, freight forwarder, consignee, owner of the cargo, manifest, history of shipper etc.

9. The radioactive material detection system of claim 1, wherein the system is also configured to detect fissile or nuclear material that emits radiation by establishing a background radiation space derived from the information sensed by the plurality of radioactive material detection apparatuses to distinguish an anomaly amongst the plurality of radioactive material detection apparatuses.

10. The radioactive material detection system of claim 1, wherein the at least one additional source includes an apparatus that measures the mass and moment of inertia properties of the cargo container.

11. The radioactive material detection system of claim 1, wherein the transmitter also transmits at least one of temperature data, tamper detection data, odor data, sound data and motion sensor data.

12. The radioactive material detection system of claim 1, further comprising a dynamic rating system for each container that is updated during transit based upon the asynchronously analyzed data.

13. The radioactive material detection system of claim 1, wherein the lack of an appropriate output signal, tampering detection or other failure from a particular radioactive material detection apparatus indicates a problem status with the associated container.

14. The radioactive material detection system of claim 26, wherein the radioactive material detection system utilizes spectral data collected and transmitted by the

radioactive material detection apparatuses to identify naturally occurring or manmade radioisotopes and eliminating the naturally occurring or manmade radioisotopes to distinguish between naturally occurring or manmade and fissile material.

15. A method of detecting radioactive material within a plurality of containers using a radioactive material detection system, the radioactive material detection system including a cargo container monitoring system and a control center, the cargo container monitoring system including a plurality of radioactive material detection apparatuses and a master unit/master module, the plurality of radioactive material detection apparatuses each having a wireless transmitter, a radiation sensor, a detection controller and an identification tag, the master unit/master module having a receiver configured to receive the wirelessly transmitted information from each of the wireless transmitters, a transceiver and a master controller, the control center being in communication with the transceiver of the master unit/master module and being configured to receive data from at least one additional source other than the master unit/master module, the method comprising:

(a) mounting the plurality of radioactive material detection apparatuses to the plurality of containers, the total set of detection apparatuses comprising an array of detector locations;

(b) using the master unit/master module and the plurality of radioactive material detection apparatuses to sense at least one of gamma radiation and neutrons at each radioactive material detection apparatus and transmit the initially sensed signal to the master unit/master module;

(c) establishing a background radiation space for the plurality of containers based upon the initially sensed signals;

(d) storing the background radiation space in the master unit/master module or the control center;

(e) sensing at least one of gamma radiation and neutrons over the predetermined or commanded period of time at each radioactive material detection apparatus and transmitting the currently sensed signal to the master unit/master module;

(f) establishing a current radiation space for the plurality of containers based upon the currently sensed signals;

(g) comparing the current radiation space as currently sensed by the radioactive material detection apparatuses to the background radiation space as initially sensed by the radioactive material detection apparatuses in order; and

(h) asynchronously analyzing the data from the at least one additional source and the compared information so as to identify an anomaly amongst the plurality of containers, to reduce false positives, to reduce false negatives and/or to increase a sensitivity reading.

16. The method of claim 15, further comprising:

(i) sensing at least one of gamma radiation and neutrons in totality and/or by spectral distribution at each radioactive material detection apparatus and transmitting initially sensed signals to the master unit/master module;

(j) sensing at least one of gamma radiation and neutrons in totality and/or by spectral distribution over the predetermined or commanded period of time at each radioactive material detection apparatus and transmitting the currently sensed signals to the master unit/master module;

(k) calculating the difference between the initially sensed and currently sensed signals, the difference representing the radiation measure at each radioactive material detection apparatus location throughout the array of radioactive material detection apparatuses over a sensing period of time;

(l) calculating an average measured radiation level at each radioactive material detection apparatus location throughout the entire array of radioactive material detection apparatuses by averaging the radiation sensed at radioactive material detection apparatuses proximate to each radioactive material detection apparatus, the set of average values for the plurality of radioactive material detection apparatuses forming a background radiation space for the plurality of radioactive material detection apparatuses and corresponding containers; and

(m) comparing the measured radiation at each radioactive material detection apparatus location to the calculated estimate of background radiation at each location in order to identify an anomaly amongst the plurality of containers.

17. The method of claim 15, wherein the identification of an anomaly is based on criteria that balance the occurrence of false positives and false negatives in a desired combination.

18. The method of claim 15, further comprising:

(h) repeating steps (c)-(h) in additional subsequent periods of time to form a set of cumulative data thereby improving the sensitivity of the detection of nuclear materials.

19. The method of claim 15, further comprising:

(h) utilizing spectral data collected and transmitted by the radioactive material detection apparatuses to identify naturally occurring isotopes and eliminating the naturally occurring radioisotopes to distinguish between naturally occurring and fissile data.

20. The method of 15, wherein the identification of an anomaly is based on criteria that balance the occurrence of false positives and false negatives in a desired combination.

21. The method of claim 15, further comprising:

(h) repeating steps (c)-(g) in additional subsequent periods of time to form a set of cumulative data thereby improving the sensitivity of the detection of nuclear materials.

22. The method of claim 15, further comprising:

(h) utilizing spectral data collected and transmitted by the radioactive material detection apparatuses to identify naturally occurring isotopes and eliminating the naturally occurring radioisotopes to distinguish between naturally occurring and fissile data.

23. A method of detecting radioactive material within a plurality of containers using a radioactive material detection system, the radioactive material detection system including a cargo container monitoring system and a control center, the cargo container monitoring system including a master unit/master module and a plurality of radioactive material detection apparatuses, each apparatus having a transmitter, a detection controller and a radiation sensor configured to detect radiation over a predetermined or commanded period of time, the control center being in communication with the master unit/master module and being configured to receive data from at least one additional source other than the master unit/master module, the method comprising:

(a) sensing radiation at each radioactive material detection apparatus;

(b) receiving sensed information from each radioactive material detection apparatus at the master unit/master module, over the predetermined or commanded period of time;

(c) adjusting for background or cosmic radiation to create adjusted sensor information and to facilitate the identification of an anomaly or unusual data which is likely to indicate the presence of nuclear radioactive material; and

(d) asynchronously analyzing the data from the at least one additional source and the adjusted sensor information so as to identify an anomaly amongst the plurality of containers, to reduce false positives, to reduce false negatives and/or to increase a sensitivity reading.

24. A radioactive material detection system comprising:

a cargo container monitoring system having a radiation sensor configured to detect radiation over a predetermined or commanded period of time and a transceiver configured to send the information received from the radiation sensor; and

a control center in communication with the transceiver of the cargo container monitoring system, the control center being configured to receive data from at least one additional source other than the cargo container monitoring system and to asynchronously analyze the data from the at least one additional source and the information from the radiation sensor, during transit, so as to detect radioactive material in a cargo container.